

CLAIMS

What is claimed is:

- 1 1. An integrated optical isolator device, comprising:
  - 2 a planar optical substrate;
  - 3 a first waveguide formed in said optical substrate and having an input
  - 4 section and an output section; and
  - 5 an isolator element affixed to said optical substrate and positioned in an
  - 6 optical path of said first waveguide between said input section and said output
  - 7 section, said isolator element being configured to allow the passage of forwardly
  - 8 traveling light from said input section to said output section of said first
  - 9 waveguide while inhibiting the passage of backwardly traveling light from said
  - 10 output section to said input section.
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- 1 2. The device of claim 1, further comprising a trench formed in said optical
- 2 substrate, said trench being oriented transversely with respect to a longitudinal
- 3 axis of said first waveguide, and wherein said trench receives and holds a lower
- 4 end of said isolator element.
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- 1 3. The device of claim 1, further comprising a second waveguide formed in said
- 2 optical substrate and having an input section and an output section, and wherein
- 3 said optical isolator element is further positioned in an optical path of said
- 4 second waveguide between said input section and said output section of said
- 5 second waveguide.
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- 1 4. The device of claim 1, wherein said isolator element comprises at least one
- 2 Faraday rotator layer interposed between birefringent layers.
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- 1       5. The device of claim 1, wherein said input section includes a first taper section  
2       for expanding forwardly traveling light from a first mode size to a second mode  
3       size.
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- 1       6. The device of claim 1, wherein said first taper section is substantially  
2       adiabatic.
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- 1       7. The device of claim 5, wherein said output section includes a second taper  
2       section for contracting forwardly traveling light from said second mode size to a  
3       third mode size.
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- 1       8. The device of claim 1, wherein a long axis of said isolator element is oriented  
2       perpendicular to an optical axis of said first waveguide.
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- 1       9. The device of claim 2, wherein said trench extends partially through a  
2       thickness of said optical substrate.
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- 1       10. The device of claim 2, wherein said optical substrate is affixed to an  
2       underlying support substrate, and said trench extends fully through a thickness  
3       of said optical substrate and partially into a thickness of said support substrate.
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- 1       11. The device of claim 1, wherein said first waveguide has an associated mode  
2       center located at least 30 microns below an upper major surface of said optical  
3       substrate.
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- 1       12. The device of claim 1, wherein said input and output sections of said first  
2       waveguide are formed simultaneously in said optical substrate.
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- 1       13. The device of claim 1, wherein said optical substrate is formed from a glass.

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1 14. The device of claim 1, wherein said first waveguide is formed by field  
2 assisted ion-exchange.

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1 15. The device of claim 2, wherein said planar optical substrate comprises  
2 separate first and second pieces, said input section being formed in said first  
3 piece and said output section being formed in said second piece, said first and  
4 second pieces being spaced apart across a gap, and said isolator element being  
5 disposed at least partially within said gap.

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1 16. The device of claim 15, wherein said first and second pieces are affixed to a  
2 common support substrate.

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1 17. An integrated optical isolator array, comprising:  
2       a planar optical substrate;  
3       a plurality of waveguides formed in said optical substrate, each one of the  
4       plurality of waveguides having an input section and an output section; and  
5       an isolator element affixed to said optical substrate and positioned in the  
6       optical paths of at least two of said waveguides between said input sections and  
7       said output sections, said isolator element being configured to allow the passage  
8       of forwardly traveling light from said input sections to said output sections of  
9       said at least two waveguides while inhibiting the passage of backwardly  
10      traveling light from said output sections to said input sections.

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1 18. The integrated optical isolator array of claim 17, further comprising a trench  
2 formed in said optical substrate, said trench being oriented transversely with  
3 respect to the longitudinal axes of said plurality of waveguides, and wherein said  
4 trench receives and holds a lower end of said isolator element.

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- 1        19. The integrated optical isolator array of claim 17, wherein said isolator  
2        element is positioned in the optical paths of all of said plurality of waveguides.  
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- 1        20. The integrated optical isolator array of claim 17, wherein said isolator  
2        element comprises at least one Faraday rotator layer interposed between  
3        birefringent layers.  
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- 1        21. The integrated optical isolator array of claim 17, wherein said input sections  
2        each include a first taper section for expanding forwardly traveling light from a  
3        first mode size to a second mode size.  
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- 1        22. The integrated optical isolator array of claim 21, wherein said first taper  
2        section is substantially adiabatic.  
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- 1        23. The integrated optical isolator array of claim 21, wherein each of said  
2        output sections includes a second taper section for contracting forwardly  
3        traveling light from said second mode size to a third mode size.  
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- 1        24. The integrated optical isolator array of claim 17, wherein a long axis of said  
2        isolator element is oriented perpendicular to the optical axes of said plurality of  
3        waveguides.  
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- 1        25. The integrated optical isolator array of claim 18, wherein said trench extends  
2        partially through a thickness of said optical substrate.  
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- 1        26. The integrated optical isolator array of claim 18, wherein said optical  
2        substrate is affixed to an underlying support substrate, and said trench extends  
3        fully through a thickness of said optical substrate and partially into a thickness of  
4        said support substrate.

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- 1 27. The integrated optical isolator array of claim 17, wherein said input and
- 2 output sections of said plurality of waveguides are formed simultaneously in
- 3 said optical substrate.
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- 1 28. The integrated optical isolator array of claim 17, wherein said optical
- 2 substrate is formed from a glass.
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- 1 29. The integrated optical isolator array of claim 18, wherein said planar optical
- 2 substrate comprises separate first and second pieces, said input section being
- 3 formed in said first piece and said output section being formed in said second
- 4 piece, said first and second pieces being spaced apart across a gap, and said
- 5 isolator element being disposed at least partially within said gap.
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- 1 30. The integrated optical isolator array of claim 29, wherein said first and
- 2 second pieces are affixed to a common support substrate.